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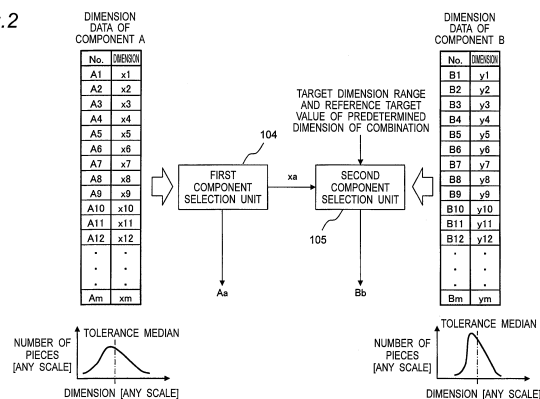
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(54) **PRODUCTION MANAGEMENT SYSTEM AND PRODUCTION MANAGEMENT METHOD**

(57) A production management system includes: a first component selection unit (104) that, when combining a component of a group of components A (first component group) and a component of a group of components B (second component group) among the plurality of component groups, preferentially selects a component Aa having a value far from a tolerance median of the group of components A,; and a second component selection unit (105) that selects, from the group of components B, a component Bb that yields a specific dimension within a target dimension range when combined with the component Aa selected from the group of components A.

Fig. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to a production management system and a production management method.

BACKGROUND ART

[0002] Conventionally, there has been a production management system that is used in a production method of combining individual components produced in lots, to make a product (see, for example, JP 2009-59220 A (Patent Literature 1)).

[0003] In the above production management system, products are produced by ranking each component on the basis of finished dimensional accuracy of a predetermined portion of each component produced in lots, and combining components of a same rank on the basis of ranking data created for each rank.

CITATIONS LIST

PATENT LITERATURE

[0004] Patent Literature 1: JP 2009-59220 A

SUMMARY OF INVENTION

TECHNICAL PROBLEMS

[0005] However, in such a production management system of combining components of a same rank, components in different ranks are not combined even if they can be combined, which causes a problem of a lower combination rate.

[0006] Accordingly, an object of the present invention is to provide a production management system and a production management method capable of improving a combination rate of constituent components.

SOLUTIONS TO PROBLEMS

[0007] A production management system according to one aspect of the present invention is a production management system for selecting components to be combined from a plurality of component groups.

[0008] The production management system includes:

a first component selection unit that, when combining a component of a first component group and a component of a second component group among the plurality of component groups, preferentially selects a component having a value far from a tolerance median of the first component group; and
a second component selection unit that selects, from the second component group, a component that

yields a specific dimension within a target dimension range when combined with the component selected from the first component group by the first component selection unit.

[0009] According to the configuration above, when combining a component of the first component group and a component of the second component group among the plurality of component groups, the first component selection unit preferentially selects a component having a value far from the tolerance median of the first component group. Then, the second component selection unit selects, from the second component group, a component that yields a specific dimension within a target dimension range when combined with the component selected from the first component group by the first component selection unit. Repeatedly selecting a component from the first component group by the first component selection unit and selecting a component by the second component selection unit from the second component group makes it possible to search for combinations of all components of the first component group with components of the second component group. Note that, when the second component group includes no component yielding the specific dimension within the target dimension range when combined with a component selected from the first component group by the first component selection unit, the component selected from the first component group is excluded from the components subject to combination.

[0010] In this way, the first component selection unit preferentially selects a component having a value far from the tolerance median of the first component group. Therefore, by selecting preferentially a component with lower dimensional accuracy and a lower probability of finding a combination partner from the first component group, and selecting a component that can be combined with that component by the second component selection unit from the second component group, it is possible to reduce the number of components that remain without being combined, as compared to the case of ranking components on the basis of finished dimensional accuracy and combining components of a same rank. Therefore, it is possible to improve the combination rate of constituent components without ranking each component on the basis of finished dimensional accuracy, and to reduce variations of a specific dimension after the combination.

[0011] Further, in a production management system of one embodiment, the first component selection unit selects a component from an outermost side with respect to the tolerance median of the first component group.

[0012] According to the above embodiment, since the first component selection unit selects a component from the outermost side with respect to the tolerance median of the first component group, the combination rate can be improved by making the selection from the first component group, starting preferentially from a component with lower dimensional accuracy and a lowest probability of finding a combination partner in the first component

group, and selecting, by the second component selection unit, from the second component group, a component that can be combined with that component.

[0013] Further, in a production management system of one embodiment, the first component selection unit selects, as the first component group, a component group having a largest variation in dimension data distribution among the plurality of component groups.

[0014] According to the above embodiment, the combination rate can be further improved since the combination is performed from a component group including many components with a low probability of finding a combination partner, by the first component selection unit selecting, as the first component group, a component group having a largest variation in dimension data distribution among the plurality of component groups.

[0015] Further, in a production management system of one embodiment, when the second component group has a plurality of components that yield the specific dimension within the target dimension range when combined with a component selected from the first component group by the first component selection unit, the second component selection unit selects a component closer to a reference target value within the target dimension range among the plurality of components.

[0016] According to the above embodiment, when the second component group has a plurality of components that yield the specific dimension within the target dimension range when combined with a component selected from the first component group by the first component selection unit, a component closer to the reference target value is selected within the target dimension range among the plurality of components. Therefore, the specific dimension of the combined components is close to the reference target value, and variations in the specific dimension after the combination can be reduced.

[0017] Further, in a production management system of one embodiment, the plurality of component groups are groups of components constituting compressors, and the first component group first selected from the plurality of component groups in the first component selection unit is of pistons each having a blade and a roller that are integrally formed.

[0018] According to the above embodiment, the first component group of compressor pistons each having the integrally formed blade and roller is first selected. Since a variation in an outer diameter dimension of these pistons is larger than that of another component to be combined, it is possible to make combinations, starting preferentially from the group (first component group) of pistons, many of which have a lower probability of finding a combination partner than that of other components.

[0019] Further, a production management method according to one aspect of the present invention is a production management method for selecting components to be combined from a plurality of component groups.

[0020] The production management method includes:

a first step of preferentially selecting, by a first component selection unit, a component having a value far from a tolerance median of a first component group in combining a component of the first component group and a component of a second component group among the plurality of component groups; and a second step of selecting, by a second component selection unit, from the second component group, a component that yields a specific dimension within a target dimension range when combined with a component selected from the first component group in the first step.

[0021] According to the above configuration, in the first step, the first component selection unit preferentially selects a component having a value far from the tolerance median of the first component group in combining a component of the first component group and a component of the second component group among the plurality of component groups. Next, in the second step, the second component selection unit selects, from the second component group, a component yielding a specific dimension within a target dimension range when combined with a component selected from the first component group in the first step. In this way, since the first component selection unit preferentially selects a component having a value far from a tolerance median of the first component group, it is possible to reduce the number of components that remain without being combined, by selecting preferentially a component with lower dimensional accuracy and a lower probability of finding a combination partner in the first component group, and selecting, by the second component selection unit from the second component group, a component that can be combined with that component. Therefore, it is possible to improve the combination rate of constituent components, and to reduce variations of a specific dimension after the combination.

ADVANTAGEOUS EFFECTS OF INVENTION

[0022] As is apparent from the above, according to the present invention, it is possible to realize the production management system and the production management method capable of improving a combination rate of constituent components, by preferentially selecting a component having a value far from a tolerance median of the first component group among the plurality of component groups, and selecting, from the second component group, a component that yields a specific dimension within a target dimension range when combined with the component selected from the first component group by the first component selection unit.

BRIEF DESCRIPTION OF DRAWINGS

[0023]

FIG. 1 is a block diagram of a production management system according to a first embodiment of the present invention.

FIG. 2 is a view for explaining an operation of the production management system.

FIG. 3 is a view for explaining an operation of a production management system according to a second embodiment of the present invention.

FIG. 4 is a cross-sectional view showing a configuration of a compressor produced with a production management system and a production management method according to a third embodiment of the present invention.

FIG. 5 is a plan view of a main part of a compression mechanism unit of the compressor.

FIG. 6 is a flowchart for explaining an assembly process of the compression mechanism unit with use of the production management system.

FIG. 7 is a flowchart for explaining another example of the assembly process of the compression mechanism unit with use of the production management system.

FIG. 8 is a view for explaining combined components from a plurality of component groups of the production management system.

DESCRIPTION OF EMBODIMENTS

[0024] Hereinafter, a production management system and a production management method according to the present invention will be described in detail with reference to the illustrated embodiments.

(First embodiment)

[0025] FIG. 1 is a block diagram of a production management system 100 according to a first embodiment of the present invention.

[0026] As shown in FIG. 1, the production management system 100 according to this first embodiment includes a dimension data input unit 101, a dimension data storage unit 102, a distribution analysis unit 103, a first component selection unit 104, a second component selection unit 105, and a combination information storage unit 106.

[0027] The dimension data input unit 101 is inputted with dimension data obtained by measuring a finished dimension of a predetermined portion of components, with use of a dimension measuring device (not shown) for each component group, in association with an identification code assigned to each component. In this first embodiment, a unit of dimension data is μm .

[0028] Further, the dimension data storage unit 102 stores the dimension data inputted to the dimension data input unit 101 for each component group in association with the identification code.

[0029] Further, the distribution analysis unit 103 analyzes the dimension data stored for each component

group in the dimension data storage unit 102, and obtains a median of drawing tolerance and a position of each component in dimension data distribution.

[0030] Here, the median of the dimension data distribution is a value located at a center of the drawing tolerance.

[0031] Further, the first component selection unit 104 preferentially selects a component having a value far from a tolerance median of the first component group, on the basis of the dimension data distribution for each component group analyzed by the distribution analysis unit 103.

[0032] Here, the first component group is determined in advance as a component group having a largest variation in the dimension data distribution among the plurality of component groups. The variation of the dimension data distribution is determined using, for example, variance, standard deviation, and the like.

[0033] In addition, the second component selection unit 105 selects, from the second component group, a component yielding a specific dimension within a target dimension range when combined with the component selected from the first component group by the first component selection unit 104.

[0034] Here, the second component group is a group of components suitable for combination with components of the first component group in a manufacturing process.

[0035] The combination information storage unit 106 stores in advance a target dimension range of a specific dimension when a component of the first component group and a component of the second component group are combined.

[0036] This specific dimension includes, for example, a level difference in a height direction of two components to be combined, a radial gap of two components to be combined, and the like, and is several μm to several tens of μm in the present embodiment.

[0037] Next, an operation of the production management system 100, that is, a production management method will be described with reference to FIG. 2.

[0038] FIG. 2 shows dimension data x_1 to x_m of a group of components A on the left side, and shows dimension data y_1 to y_m of a group of components B on the right side. Identification codes A_1 to A_m are assigned to the group of components A, and identification codes B_1 to B_m are assigned to the group of components B. This group of components A is a first component group, and the group of components B is a second component group.

[0039] The dimension data x_1 to x_m of the group of components A are obtained by analyzing, by the distribution analysis unit 103, the dimension data stored for each component group in the dimension data storage unit 102, and arranging in order from the smallest x_1 to the largest x_m of the dimension data of the group of components A, but rearrangement of the data is not performed in the dimension data storage unit 102. At this time, the distribution analysis unit 103 obtains a median of drawing tolerance of the component A.

[0040] Similarly, for the dimension data y_1 to y_m of the group of components B, dimension data for the component group stored in the dimension data storage unit 102 is analyzed by the distribution analysis unit 103. At this time, the distribution analysis unit 103 obtains a median of drawing tolerance of the group of components B.

[0041] Then, on the basis of dimension data distribution of the group of components A, the first component selection unit 104 preferentially selects a component Aa (dimension data x_a) having a value far from the tolerance median (first step). Here, the component Aa indicates an a-th component among A1 to Am.

[0042] Next, on the basis of the dimension data x_a of the component Aa, the second component selection unit 105 selects, from the group of components B, a component Bb (dimension data y_b) that yields a specific dimension (for example, $(x_a - y_b)$) within a target dimension range S_{AB1} to S_{AB2} when combined with the component Aa selected from the group of components A by the first component selection unit 104 (second step). Here, the component Bb indicates a b-th component among B1 to Bm.

[0043] In this way, when a set of the component Aa and the component Bb is selected, the component Aa is excluded from the next selection from the dimension data of the group of components A, while the component Bb is excluded from the next selection from the dimension data of the group of components B. Note that, when there is no component B that yields a specific dimension (for example, $(x_a - y_b)$) within the target dimension range S_{AB1} to S_{AB2} when combined with the component Aa, the component Aa is excluded from the next selection from the dimension data of the group of components A, and the dimension data storage unit 102 stores information indicating that there is no combination component, in association with the component Aa.

[0044] Further, the identification codes of the component Aa and the component Bb as a selection result are outputted to a component picking device (not shown) as a selection signal, and the component picking device takes out Aa and Bb corresponding to the identification codes from a housing that individually houses the groups of components A and components B.

[0045] In this way, when a set of the component Aa and the component Bb is selected, or the component Aa is excluded from the selection as there is no component B to be combined with the component Aa, the process returns to the first step. Then, on the basis of dimension data distribution of the group of components A, the first component selection unit 104 preferentially selects a component A having a value far from the tolerance median, and determines a combination of the component A and the component B until there is no selection target (i.e., selectable component) from the group of components A left in the dimension data storage unit 102.

[0046] In this case, the component A is selected from an outer side of the tolerance median of the dimension data distribution of the group of components A. More spe-

cifically, the component having a larger absolute value of a difference from the tolerance median is selected out of a component A having a largest dimension and a component A having a smallest dimension in the dimension data distribution.

[0047] In the first embodiment above, on the basis of the selection result of the components A and B, the components are taken out from the housing by the component picking device. However, without limiting to this, a person may take out the components from the housing in accordance with display or print of the selection result of the components A and B.

[0048] According to the production management system and production management method configured as described above, in combining a component of the group of components A (first component group) and a component of the group of components B (second component group) among the plurality of component groups, the first component selection unit 104 preferentially selects a component Aa having a value far from the tolerance median of the group of components A. Then, the second component selection unit 105 selects, from the group of components B, a component Bb that yields a specific dimension within the target dimension range S_{AB1} to S_{AB2} when combined with the component Aa selected from the group of components A. By repeatedly selecting components from the group of components A by the first component selection unit 104 and selecting components from the group of components B by the second component selection unit 105, combinations for all components in the group of components A with components in the group of components B are searched for. Here, when there is no component in the group of components B that yields the specific dimension within the target dimension range when combined with a component selected from the group of components A by the first component selection unit 104, the component selected from the group of components A is excluded from the combination.

[0049] In this way, the first component selection unit 104 preferentially selects a component having a value far from a tolerance median of the group of components A. Therefore, by selecting preferentially a component with lower dimensional accuracy and a lower probability of finding a combination partner in the group of components A, and selecting a component that can be combined with that component from the group of components B by the second component selection unit 105, it is possible to reduce the number of components that remain without being combined, as compared to the case of ranking components on the basis of finished dimensional accuracy and combining components of a same rank. Therefore, it is possible to improve the combination rate of constituent components without ranking each component on the basis of finished dimensional accuracy, and to reduce variations of a specific dimension after the combination.

[0050] In addition, since the first component selection unit 104 selects the component Aa from an outermost,

or farthest side with respect to the tolerance median of the group of components A, the combination rate can be improved by making the selection, starting preferentially from a component with lower dimensional accuracy and a lowest probability of finding a combination partner, and selecting a component that can be combined with that component from the group of components B by the second component selection unit 105.

[0051] In addition, by the first component selection unit 104 selecting, as the group of components A, a component group having a largest variation in the dimension data distribution among the plurality of component groups, the combination is performed from a component group including many components with a low probability of finding a combination partner, and therefore the combination rate can be further improved.

[0052] In addition, when there are a plurality of components in the group of components B that yield a specific dimension within the target dimension range S_{AB1} to S_{AB2} when combined with the component Aa selected from the group of components A by the first component selection unit 104, a component closer to the reference target value S_{AB0} in the target dimension range S_{AB1} to S_{AB2} is selected among the plurality of components. This reference target value S_{AB0} is to be a median of the target dimension range S_{AB1} to S_{AB2} .

[0053] This allows the specific dimension of the combined component to be close to the reference target value S_{AB0} , and can reduce variations in the specific dimension after the combination.

(Second embodiment)

[0054] FIG. 3 is a view for explaining an operation (production management method) of a production management system 100 according to a second embodiment of the present invention. The production management system 100 of this second embodiment has the same configuration as the production management system 100 of the first embodiment, except that components to be combined are selected from three groups of components A, B, and C. Therefore, FIG. 1 is used.

[0055] FIG. 3 shows dimension data x_1 to x_m of a group of components A on the left side, and shows dimension data y_1 to y_m of a group of components B and dimension data z_1 to z_m of a group of components C on the right side. Identification codes A1 to Am are assigned to the group of components A, identification codes B1 to Bm are assigned to the group of components B, and identification codes C1 to Cm are assigned to the group of components C.

[0056] The group of components A is a first component group, and the groups of components B and C are second component groups.

[0057] Further, similarly to the groups of components A and B, the dimension data z_1 to z_m of the group of components C are obtained by analyzing, by a distribution analysis unit 103, dimension data stored for each

component group in a dimension data storage unit 102, and arranging in order from the smallest z_1 to the largest z_m of the dimension data of the group of components C, but rearrangement of the dimension data is not performed in the dimension data storage unit 102. At this time, the distribution analysis unit 103 obtains a median of drawing tolerance of the group of components C.

[0058] In the production management system 100 of the second embodiment, as shown in FIG. 3, a component Aa in the group of components A and a component Bb in the group of components B are selected as in the first embodiment shown in FIG. 2.

[0059] Next, for a component C to be combined with the component Aa and the component Bb, the second component selection unit 105 selects, from the group of components C on the basis of the dimension data x_a of the component Aa, a component Cc (dimension data z_c) that yields a specific dimension (for example, $(x_a - z_c)$) within a target dimension range S_{AC1} to S_{AC2} when combined with the component Aa selected from the group of components A by a first component selection unit 104. Here, the component Cc indicates a c-th component among C1 to Cm.

[0060] In this way, when a set of the component Aa, the component Bb, and the component Cc is selected, the component Aa is excluded from the next selection from the dimension data of the group of components A, while the component Bb is excluded from the next selection from the dimension data of the group of components B. Further, the component Cc is excluded from the next selection from the dimension data of the group of components C.

[0061] Note that, even when there is no component C that yields a specific dimension (for example, $(x_a - z_c)$) when combined with the component Aa within the target dimension range S_{AC1} to S_{AC2} , the component Aa is excluded from the next selection from the dimension data of the group of components A, and the dimension data storage unit 102 stores information indicating that there is no combination component in association with the component Aa.

[0062] Further, the identification codes of the component Aa, the component Bb, and the component Cc as a selection result are outputted to a component picking device (not shown) as a selection signal, and the component picking device takes out components Aa, Bb, and Cc corresponding to the identification codes from a housing that individually houses the groups of components A, components B, and components C.

[0063] In the second embodiment, the component Cc (dimension data z_c) that yields a specific dimension (for example, $(x_a - z_c)$) within the target dimension range S_{AC1} to S_{AC2} when combined with the component Aa selected from the group of components A is selected from the group of components C. However, it is possible to select, from the group of components C, a component Cc (dimension data z_c) that yields a specific dimension (for example, $(y_b - z_c)$) within a target dimension range

S_{BC1} to S_{BC2} when combined with the component Ba selected from the group of components B. The component that yields a specific dimension within the target dimension range when combined with a third component is appropriately determined in accordance with constituent components of the product to be assembled.

[0064] Alternatively, the component yielding a specific dimension within the target dimension range when combined with a third component may be both of the components A and B. That is, a combination dimension specified with the components A, B, and C combined may be used, which may be, for example, a total thickness of the components A, B, and C (thickness of component A + thickness of component B + thickness of component C), or the like.

[0065] In this way, when a set of the component Aa, the component Bb, and the component Cc is selected, or the component Aa is excluded from the selection as there is no component B or component C to be combined with the component Aa, next, on the basis of dimension data distribution of the group of components A, the first component selection unit 104 preferentially selects a component A having a value far from the tolerance median, and determines a combination of the component A, a component B, and a component C, which process is repeated until there is no selection target left in the group of components A in the dimension data storage unit 102.

[0066] The production management system and production management method of the second embodiment have effects similar to those of the production management system and production management method of the first embodiment.

[0067] Further, although the components to be combined are selected from the three groups of components A, B, and C in the second embodiment, the components to be combined may be selected from four or more groups of components. In this case, a component group for selecting a component that yields a specific dimension within a target dimension range when combined with the fourth or subsequent component is determined appropriately, as with the component C, in accordance with constituent components of the assembled product, the manufacturing process, and the like.

(Third embodiment)

[0068] FIG. 4 shows a configuration of a compressor produced with a production management system and a production management method according to a third embodiment of the present invention.

[0069] As shown in FIG. 4, the compressor includes a hermetic container 1, a compression mechanism unit 2 disposed in this hermetic container 1, and a motor 3 that is disposed in the hermetic container 1 and drives the compression mechanism unit 2 via a crankshaft 12. The compressor is a so-called vertical high-pressure dome-type rotary compressor, and the compression mechanism unit 2 is arranged in a lower part of the hermetic container 1, and the motor 3 is arranged above the compression mechanism unit 2. A rotor 6 of this motor 3 is to drive the compression mechanism unit 2 via the crankshaft 12.

nism unit 2 is arranged in a lower part of the hermetic container 1, and the motor 3 is arranged above the compression mechanism unit 2. A rotor 6 of this motor 3 is to drive the compression mechanism unit 2 via the crankshaft 12.

[0070] The compression mechanism unit 2 takes in refrigerant gas through a suction pipe 11. Further, the refrigerant gas is compressed by the compression mechanism unit 2 to become high temperature and high pressure, and then discharged from the compression mechanism unit 2 to fill the hermetic container 1. At this time, the refrigerant gas passes through a gap between a stator 5 and the rotor 6, cools the motor 3, and then is discharged outside from a discharge pipe 13 provided above the motor 3.

[0071] Further, the compression mechanism unit 2 includes a cylinder 21 to define a cylinder chamber 22, a front head 50 attached to an upper end of this cylinder 21 and located on the cylinder 21, and a rear head 60 attached to a lower end of the cylinder 21 and located under the cylinder 21. The cylinder chamber 22 is formed by the cylinder 21, the front head 50, and the rear head 60. This cylinder chamber 22 houses a piston 29 for compression of the refrigerant gas.

[0072] The front head 50 has a disk-shaped main body 51 and a boss 52 that protrudes upward from a center of this main body 51. The crankshaft 12 is rotatably inserted into the main body 51 and the boss 52. Note that the boss 52 is an example of an upper bearing. The main body 51 is provided with a discharge port 51a that communicates with the cylinder chamber 22.

[0073] Further, the rear head 60 includes a disk-shaped main body 61 and a boss 62 that protrudes downward from a center of this main body 61. The crankshaft 12 is rotatably inserted into the main body 61 and the boss 62.

[0074] Thus, a lower portion of the crankshaft 12 is supported by the front head 50 and the rear head 60. In this lower portion of the crankshaft 12, a portion located between the front head 50 and the rear head 60 enters the cylinder chamber 22.

[0075] Further, an eccentric portion 26 is provided at the lower portion of the crankshaft 12 so as to be located in the cylinder chamber 22. The eccentric portion 26 is fitted to a roller 27 of the piston 29. The piston 29 is arranged in the cylinder chamber 22 so as to be capable of revolving, and the revolving motion of the piston 29 causes a compression action.

[0076] FIG. 5 is a plan view of a main part of the compression mechanism unit 2 of the compressor.

[0077] The compressor includes the piston 29 having the roller 27 and a blade 28 that are integrally formed. The blade 28 of the piston 29 partitions the inside of the cylinder chamber 22 into a suction chamber (low pressure chamber) 22a that takes in refrigerant gas from the suction pipe 11, and a discharge chamber (high pressure chamber) 22b in which the discharge port 51a (shown in FIG. 1) opens on an inner surface of the cylinder chamber

22.

[0078] Further, a pair of semi-cylindrical bushes 25 and 25 is brought into close contact with both side surfaces of the blade 28, and the bushes 25 and 25 seal spaces adjacent to both side surfaces of the blade 28. These bushes 25 and 25 support the blade 28 such that the blade 28 is able to advance and retract, by sandwiching it from both sides.

[0079] When the eccentric portion 26 of the crankshaft 12 rotates eccentrically, the roller 27 of the piston 29 revolves with an outer peripheral surface of the roller 27 being in contact with an inner peripheral surface of the cylinder chamber 22.

<Assembly of compression mechanism unit>

[0080] In an assembly process of the compression mechanism unit 2 of the compressor, the production management system 100 of the second embodiment is used. Prior to this assembly process, the piston 29, the cylinder 21, the crankshaft 12, the front head 50, and the rear head 60, which constitute the compression mechanism unit 2, are produced in lots by machining.

[0081] Then, dimension data is measured with use of a dimension measuring device (not shown) for each lot of the produced piston 29, cylinder 21, crankshaft 12, front head 50, and rear head 60, and the measured dimension data is inputted to the dimension data input unit 101 (shown in FIG. 1) in association with an identification code assigned to each component.

[0082] Then, the dimension data storage unit 102 stores the dimension data inputted to the dimension data input unit 101 for each component group in association with the identification code.

[0083] Here, the dimension data of each component is:

piston 29: height, inner diameter, outer diameter, blade width,
cylinder 21: height, inner diameter,
crankshaft 12: shaft outer diameter, outer diameter of eccentric portion, eccentric amount of eccentric portion,
front head 50: inner diameter of shaft bore, and
rear head 60: inner diameter of shaft bore.

Note that the shaft outer diameter of the crankshaft 12 is an outer diameter of a shaft portion of the crankshaft 12 corresponding to the shaft bore of the front head 50 and the shaft bore of the rear head 60.

[0084] Further, the distribution analysis unit 103 analyzes the dimension data stored for each component group in the dimension data storage unit 102, to obtain a median of drawing tolerance for each component group and a position of each component in dimension data distribution.

[0085] FIG. 6 is a flowchart for explaining the assembly process of the compression mechanism unit 2, with use of the production management system 100.

[0086] First, when assembly starts, the piston 29 is selected in step S1. At this time, the first component selection unit 104 (shown in FIG. 1) selects a piston 29 from an outermost side with respect to a tolerance median of the group of pistons 29 (first component group) on the basis of the dimension data distribution for the component group analyzed by the distribution analysis unit 103. That is, the first component selection unit 104 selects a piston 29 having a largest absolute value of a difference from the tolerance median.

[0087] Next, the process proceeds to step S2, and the cylinder 21 is selected. That is, a cylinder 21 to be combined with the piston 29 selected in step S1 is selected from a group of cylinders 21 (second component group). At this time, the second component selection unit 105 (shown in FIG. 1) selects, from the group of cylinders 21 (second component group), a cylinder 21 that yields a specific dimension within a target dimension range when combined with the piston 29 selected in step S1.

[0088] The specific dimension and the target dimension range in this combination of the piston 29 and the cylinder 21 are stored in the combination information storage unit 106 (shown in FIG. 1). The specific dimension and the target dimension range therefor are the following two, (1) and (2). A cylinder 21 that satisfies both (1) and (2) is selected.

(1) A gap in a width direction of a bush hole of the cylinder 21 [inner diameter of bush hole of cylinder 21 - total width of two bushes 25 - blade width of piston 29]

The target dimension range is a range allowed for a reference target value of the gap in the width direction.

(2) A level difference in a height direction [height of cylinder 21 - height of piston 29]

The target dimension range is a range allowed for a reference target value of the level difference in the height direction.

[0089] Note that, when there are a plurality of cylinders 21, in the group of cylinders 21 (second component group), that yield the specific dimension within the respective target dimension range when combined with the piston 29 selected by the first component selection unit 104, a cylinder 21 closer to a reference target value within the target dimension range is selected among the plurality of cylinders 21. This allows the level difference in the height direction (specific dimension) between the combined piston 29 and cylinder 21 to be close to the reference target value, and can reduce variations in the specific dimension after the combination.

[0090] Next, the process proceeds to step S3, and the crankshaft 12 is selected. That is, a crankshaft 12 to be combined with the piston 29 selected in step S1 is selected from a group of crankshafts 12 (second component group). At this time, the second component selection unit 105 selects, from the group of crankshafts 12 (sec-

ond component group), a crankshaft 12 that yields a specific dimension within a target dimension range when combined with the piston 29 selected in step S1.

[0091] The specific dimension and the target dimension range in this combination of the piston 29 and the crankshaft 12 are stored in the combination information storage unit 106. The specific dimension is a radial gap [inner diameter of piston 29 - outer diameter of eccentric portion 26 of crankshaft 12], and the target dimension range is a range allowed for a reference target value of this radial gap.

[0092] Next, the process proceeds to step S4, and the front head 50 is selected. That is, a front head 50 to be combined with the crankshaft 12 selected in step S3 is selected from a group of front heads 50 (second component group). At this time, the second component selection unit 105 selects, from the group of front heads 50 (second component group), a front head 50 that yields a specific dimension within a target dimension range when combined with the crankshaft 12 selected in step S3.

[0093] The specific dimension and the target dimension range in this combination of the front head 50 and the crankshaft 12 are stored in the combination information storage unit 106. The specific dimension is a radial gap [inner diameter of shaft bore of front head 50 - outer diameter of crankshaft 12], and the target dimension range is a range allowed for a reference target value of the radial gap.

[0094] Next, the process proceeds to step S5, and a rear head 60 is selected. That is, a rear head 60 to be combined with the crankshaft 12 selected in step S3 is selected from a group of rear heads 60 (second component group). At this time, the second component selection unit 105 selects, from the group of rear heads 60 (second component group), a rear head 60 that yields a specific dimension within a target dimension range when combined with the crankshaft 12 selected in step S3.

[0095] The specific dimension and the target dimension range in this combination of the rear head 60 and the crankshaft 12 are stored in the combination information storage unit 106. The specific dimension is a radial gap [inner diameter of shaft bore of rear head 60 - outer diameter of crankshaft 12], and the target dimension range is a range allowed for a reference target value of the radial gap.

[0096] The combination of the constituent components of the compression mechanism unit 2 is determined by the above steps S1 to S5. Then, in the production management system 100, the selected individual piston 29, cylinder 21, crankshaft 12, front head 50, and rear head 60 are excluded from the next selection, with use of the identification code of each component, from the dimension data stored in the dimension data storage unit 102.

[0097] Then, by repeating steps S1 to S5, combinations of constituent components of the compression mechanism unit 2 are determined until there is no selection target left in the group of pistons 29 in the dimension data storage unit 102.

[0098] FIG. 7 is a flowchart for explaining another example of the assembly process of the compression mechanism unit, with use of the production management system 100. This assembly process described in FIG. 7 is different from the assembly process of FIG. 6 in that the crankshaft 12, the piston 29, and the cylinder 21 are selected in this order.

[0099] First, the crankshaft 12 is selected in step S11. At this time, the first component selection unit 104 selects a crankshaft 12 from an outermost side with respect to a tolerance median of the group of crankshafts 12 (first component group) on the basis of the dimension data distribution for the component group analyzed by the distribution analysis unit 103. That is, the first component selection unit 104 selects a piston 29 having a largest absolute value of a difference from the tolerance median.

[0100] Next, the process proceeds to step S12, and the piston 29 is selected. That is, a piston 29 to be combined with the crankshaft 12 selected in step S11 is selected from a group of pistons 29 (second component group). At this time, the second component selection unit 105 selects, from the group of pistons 29 (second component group), a piston 29 that yields a specific dimension within a target dimension range when combined with the crankshaft 12 selected in step S11.

[0101] The specific dimension and the target dimension range in this combination of the crankshaft 12 and the piston 29 are stored in the combination information storage unit 106. The specific dimension is a radial gap [inner diameter of piston 29 - outer diameter of eccentric portion 26 of crankshaft 12], and the target dimension range is a range allowed for a reference target value of the radial gap.

[0102] Next, the process proceeds to step S13, and the cylinder 21 is selected. That is, a cylinder 21 to be combined with the piston 29 selected in step S12 is selected from a group of cylinders 21 (second component group). At this time, the second component selection unit 105 selects, from the group of cylinders 21 (second component group), a cylinder 21 that yields a specific dimension within a target dimension range when combined with the piston 29 selected in step S12.

[0103] The specific dimension and the target dimension range in this combination of the piston 29 and the cylinder 21 are stored in the combination information storage unit 106. The specific dimension and the target dimension range therefor are the following two, (i) and (ii). A cylinder 21 that satisfies both (i) and (ii) is selected.

(i) A gap in a width direction of a bush hole of the cylinder 21 [inner diameter of bush hole of cylinder 21 - total width of two bushes 25 - blade width of piston 29]

The target dimension range is a range allowed for a reference target value of the gap in the width direction

(ii) A level difference in a height direction [height of cylinder 21 - height of piston 29]

The target dimension range is a range allowed for a reference target value of the level difference in the height direction

[0104] Next, the process proceeds to step S14, and the front head 50 is selected. That is, a front head 50 to be combined with the crankshaft 12 selected in step S11 is selected from a group of front heads 50 (second component group). At this time, the second component selection unit 105 selects, from the group of front heads 50 (second component group), a front head 50 that yields a specific dimension within a target dimension range when combined with the crankshaft 12 selected in step S11.

[0105] The specific dimension and the target dimension range in this combination of the front head 50 and the crankshaft 12 are stored in the combination information storage unit 106. The specific dimension is a radial gap [inner diameter of shaft bore of front head 50 - outer diameter of crankshaft 12], and the target dimension range is a range allowed for a reference target value of the radial gap.

[0106] Next, the process proceeds to step S15, and the rear head 60 is selected. That is, a rear head 60 to be combined with the crankshaft 12 selected in step S11 is selected from a group of rear heads 60 (second component group). At this time, the second component selection unit 105 selects, from the group of rear heads 60 (second component group), a rear head 60 that yields a specific dimension within a target dimension range when combined with the crankshaft 12 selected in step S11.

[0107] The specific dimension and the target dimension range in this combination of the rear head 60 and the crankshaft 12 are stored in the combination information storage unit 106. The specific dimension is a radial gap [inner diameter of shaft bore of rear head 60 - outer diameter of crankshaft 12], and the target dimension range is a range allowed for a reference target value of the radial gap.

[0108] The combination of the constituent components of the compression mechanism unit 2 is determined by the above steps S11 to S15. Then, in the production management system 100, the selected individual piston 29, cylinder 21, crankshaft 12, front head 50, and rear head 60 are excluded from the next selection, with use of the identification code of each component, from the dimension data stored in the dimension data storage unit 102.

[0109] Then, by repeating steps S11 to S15, combinations of constituent components of the compression mechanism unit 2 are determined until there is no selection target left in the group of crankshafts 12 in the dimension data storage unit 102.

[0110] FIG. 8 shows an example of combination components of a plurality of component groups of the production management system.

[0111] For example, when the combination components are a cylinder and a piston, the level difference in the height direction (cylinder height - piston height) is the specific dimension. Note that the cylinder height is set to

be larger than the piston height.

[0112] Further, when the combination components are a cylinder and a bush, the level difference in the height direction (cylinder height - bush height) is the specific dimension. Note that the cylinder height is set to be larger than the bush height.

[0113] Further, when the combination components are a front head and a crankshaft, a radial gap (inner diameter of shaft bore of front head - outer diameter of crankshaft) is the specific dimension. Note that the inner diameter of the shaft bore of the front head is set to be larger than the outer diameter of the crankshaft.

[0114] Further, when the combination components are a rear head and a crankshaft, a radial gap (inner diameter of shaft bore of rear head - outer diameter of crankshaft) is the specific dimension. Note that the inner diameter of the shaft bore of the rear head is set to be larger than the outer diameter of the crankshaft.

[0115] Further, when the combination components are a piston and a crankshaft, a radial gap (inner diameter of piston - outer diameter of eccentric portion of crankshaft) is the specific dimension. Note that the inner diameter of piston is set to be larger than the outer diameter of the eccentric portion of the crankshaft.

[0116] Further, when the combination components are three of a crankshaft, a piston, and a cylinder, a radial gap (inner diameter of cylinder - outer diameter of piston - eccentricity of eccentric portion of crankshaft) is the specific dimension. Note that the inner diameter of the cylinder is set to be larger than (the outer diameter of the piston plus the eccentric amount of the eccentric portion of the crankshaft).

[0117] Furthermore, when the combination components are three of a cylinder, a bush, and a piston, a radial gap (inner diameter of cylinder bush hole - total width of two bushes - blade width of piston) is the specific dimension. Note that the inner diameter of the cylinder bush hole is set to be larger than (the total width of two bushes minus the blade width of the piston).

[0118] In the production management system and production management method configured as described above, first, the group of components A, each of which is the compressor piston 29 integrally formed with the blade 28 and the roller 27, is selected. Since a variation in an outer diameter dimension of this piston 29 is larger than that of another component to be combined, it is possible to make combinations, starting preferentially from the group of pistons 29, many of which have a lower probability of finding a combination partner than that of other components.

[0119] The production management system and production management method of the third embodiment have effects similar to those of the production management system and production management method of the second embodiment.

[0120] In the third embodiment, the production management system and the production management method used for compressor production have been described.

However, the production management system and the production management method according to the present invention can be applied for selecting components constituting other products, without limiting to the compressor.

[0121] Although specific embodiments of the present invention have been described, the present invention is not limited to the first to third embodiments, but may be implemented by making various modifications within the scope of the present invention. For example, an appropriate combination of the contents described in the first to third embodiments may be used as one embodiment of the present invention.

REFERENCE SIGNS LIST

[0122]

1	hermetic container
2	compression mechanism unit
3	motor
5	stator
6	rotor
11	suction pipe
12	crankshaft
13	discharge pipe
21	cylinder
22	cylinder chamber
22a	suction chamber
22b	discharge chamber
25	bush
26	eccentric portion
27	roller
28	blade
29	piston
50	front head
51	main body
51a	discharge port
52	boss
60	rear head
61	main body
62	boss
100	production management system
101	dimension data input unit
102	dimension data storage unit
103	distribution analysis unit
104	first component selection unit
105	second component selection unit
106	combination information storage unit

Claims

1. A production management system for selecting components to be combined from a plurality of component groups, the production management system comprising:

a first component selection unit (104) that, when combining a component of a first group of components and a component of a second component group among the plurality of component groups, preferentially selects a component having a value far from a tolerance median of the first component group; and
a second component selection unit (105) that selects, from the second component group, a component that yields a specific dimension within a target dimension range when combined with the component selected from the first component group by the first component selection unit (104).

2. The production management system according to claim 1, wherein
the first component selection unit (104) selects a component from an outermost side with respect to a tolerance median of the first component group.

3. The production management system according to claim 1 or 2, wherein
the first component selection unit (104) selects, as the first component group, a component group having a largest variation in dimension data distribution among the plurality of component groups.

4. The production management system according to any one of claims 1 to 3, wherein
when the second component group has a plurality of components that yield the specific dimension within the target dimension range when combined with a component selected from the first component group by the first component selection unit (104), the second component selection unit (105) selects a component closer to a reference target value within the target dimension range among the plurality of components.

5. The production management system according to any one of claims 1 to 4, wherein
the plurality of component groups are groups of components constituting compressors, and
the first component group first selected from the plurality of component groups in the first component selection unit (104) is of pistons (29) each having a blade (28) and a roller (27) that are integrally formed.

6. A production management method for selecting components to be combined from a plurality of component groups, the production management method comprising:

a first step of preferentially selecting, by a first component selection unit (104), a component having a value far from a tolerance median of a first component group in combining a compo-

ment of the first component group and a component of a second component group among the plurality of component groups; and
a second step of selecting, by a second component selection unit (105), from the second component group, a component that yields a specific dimension within a target dimension range when combined with the component selected from the first component group by the first step.

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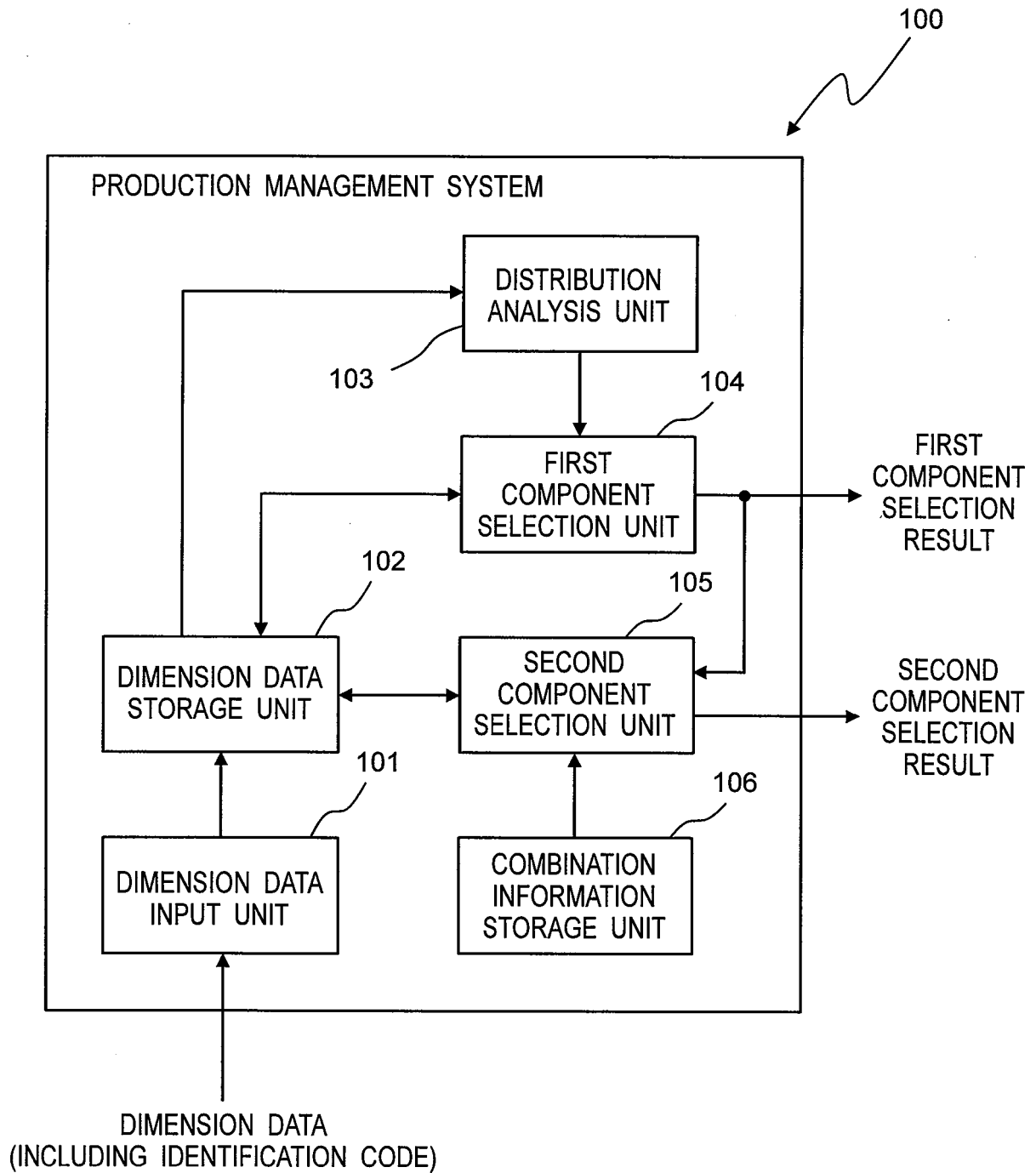
Fig.1

Fig.2

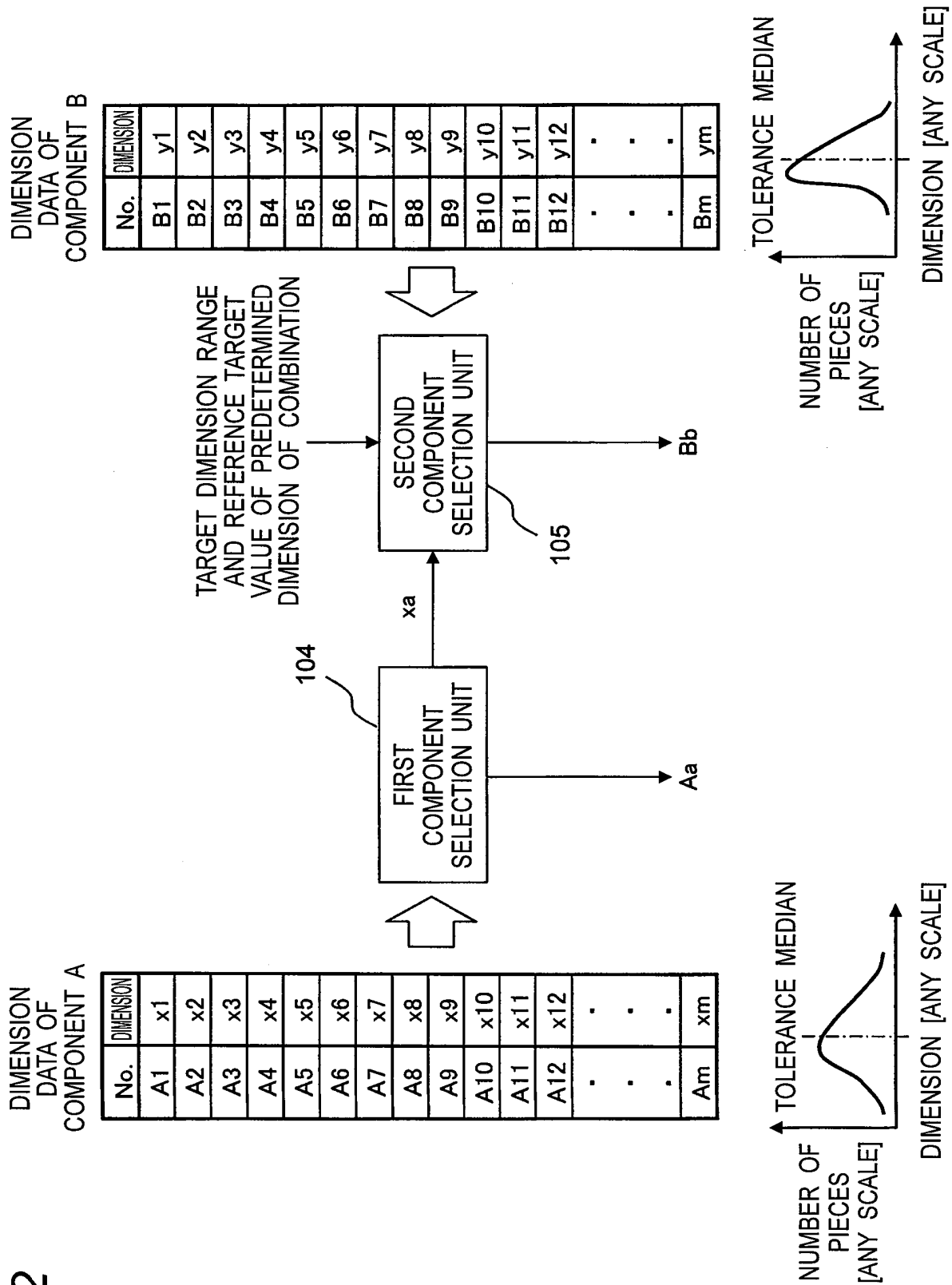


Fig.3

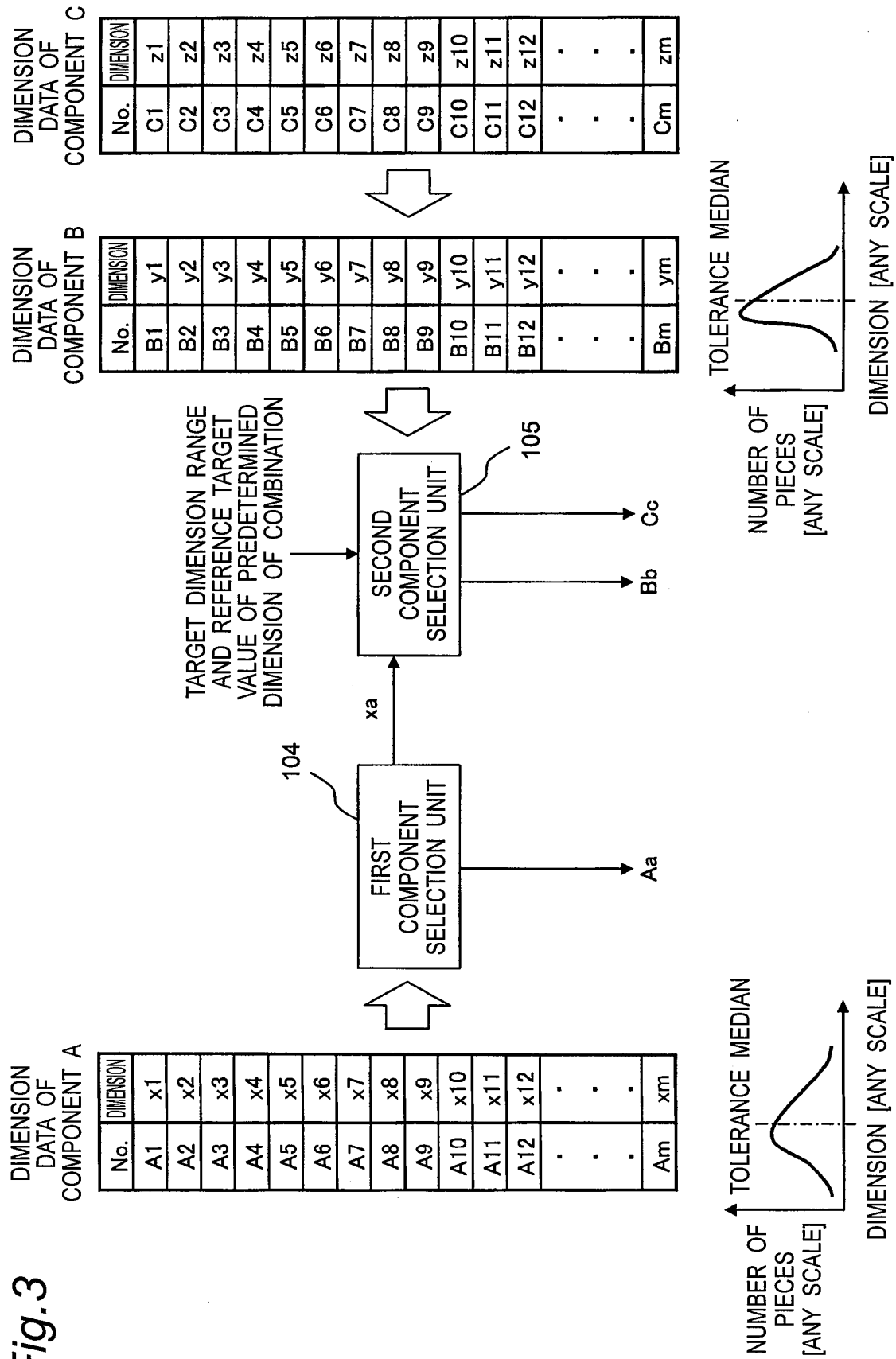


Fig.4

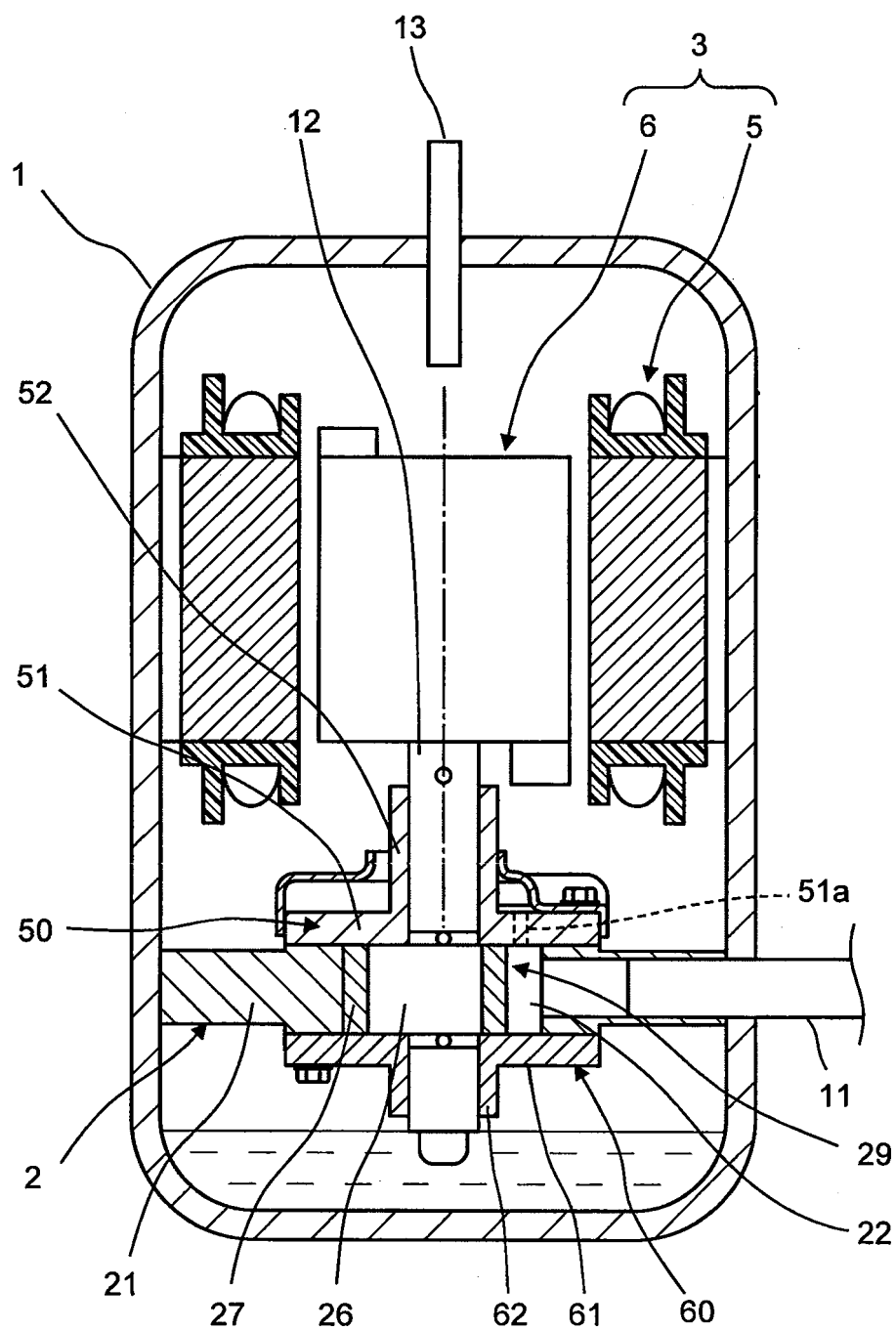


Fig.5

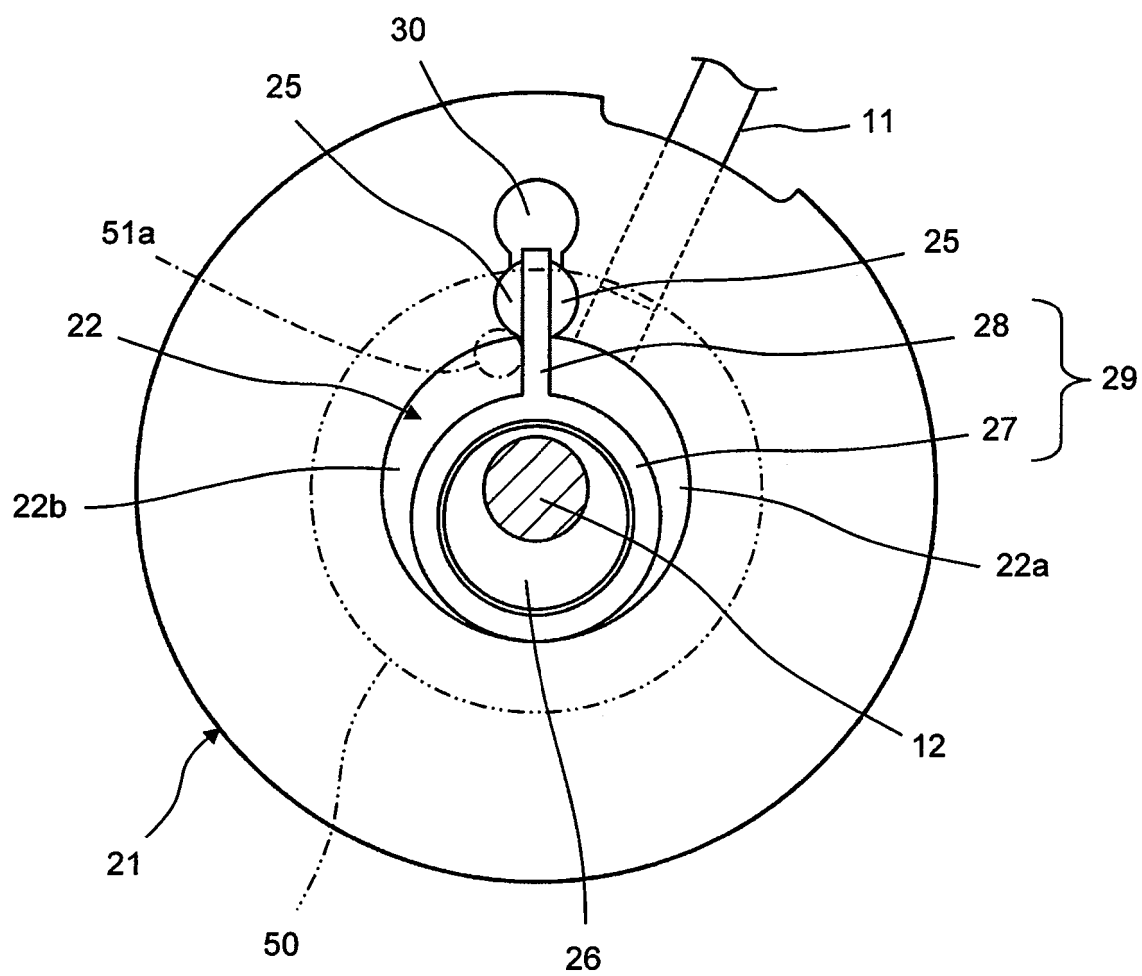


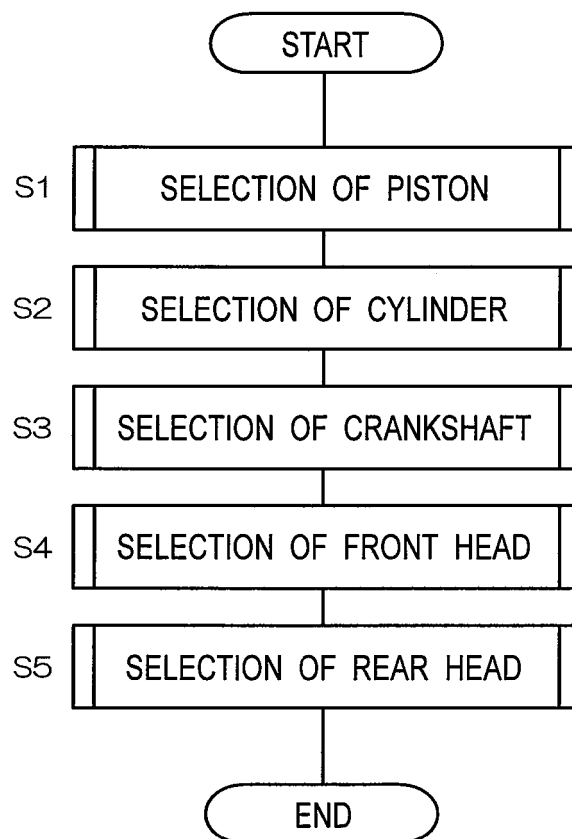
Fig.6

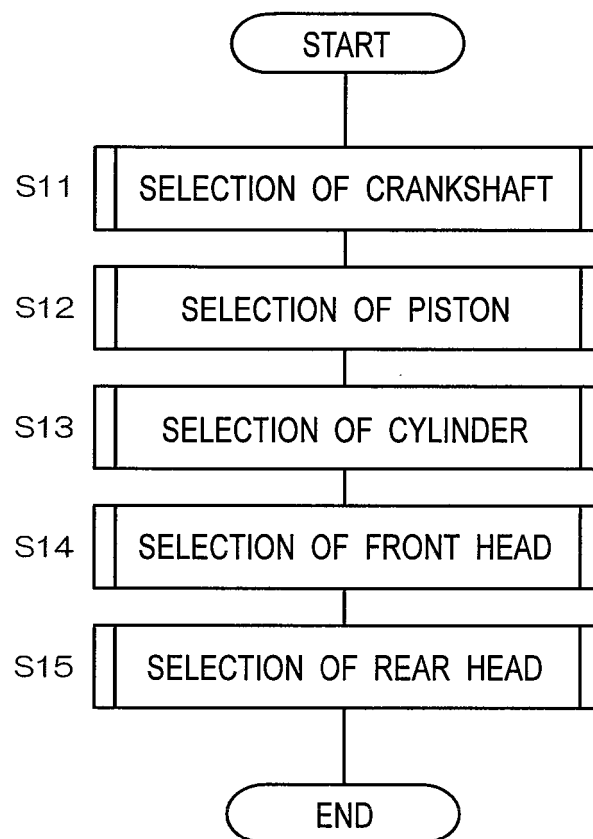
Fig.7

Fig.8

COMBINED COMPONENTS	PREDETERMINED DIMENSION	
CYLINDER PISTON	LEVEL DIFFERENCE IN HEIGHT DIRECTION	CYLINDER HEIGHT – PISTON HEIGHT
CYLINDER BUSH	LEVEL DIFFERENCE IN HEIGHT DIRECTION	CYLINDER HEIGHT – BUSH HEIGHT
FRONT HEAD CRANKSHAFT	RADIAL GAP	INNER DIAMETER OF SHAFT BORE OF FRONT HEAD – OUTER DIAMETER OF CRANKSHAFT
REAR HEAD CRANKSHAFT	RADIAL GAP	INNER DIAMETER OF SHAFT BORE OF REAR HEAD – OUTER DIAMETER OF CRANKSHAFT
PISTON CRANKSHAFT	RADIAL GAP	INNER DIAMETER OF PISTON – OUTER DIAMETER OF ECCENTRIC PORTION OF CRANKSHAFT
CRANKSHAFT PISTON CYLINDER	RADIAL GAP	INNER DIAMETER OF CYLINDER – OUTER DIAMETER OF PISTON – AMOUNT OF ECCENTRICITY OF ECCENTRIC PORTION OF CRANKSHAFT
CYLINDER BUSH PISTON	GAP IN WIDTH DIRECTION OF BUSH PORTION	INNER DIAMETER OF BUSH HOLE OF CYLINDER – TOTAL WIDTH OF TWO BUSHES – BLADE WIDTH OF PISTON

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/017999

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. B23P21/00 (2006.01) i, G05B19/418 (2006.01) i, G06Q50/04 (2012.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. B23P21/00, G05B19/418, G06Q50/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2018

Registered utility model specifications of Japan 1996-2018

Published registered utility model applications of Japan 1994-2018

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2009-265983 A (OMRON CORP.) 12 November 2009, paragraphs [0016]-[0025], [0032]-[0044], fig. 1-5 (Family: none)	1-4, 6
Y		5
Y	JP 2010-25103 A (DAIKIN INDUSTRIES, LTD.) 04 February 2010, paragraph [0001], fig. 1 & CN 101725531 A	5
A	JP 9-314431 A (FUJII OOX INC.) 09 December 1997, abstract, claim 1, paragraph [0067] (Family: none)	1-6



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

30 July 2018 (30.07.2018)

Date of mailing of the international search report

07 August 2018 (07.08.2018)

Name and mailing address of the ISA/

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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